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Application and Practice of Project-based Teaching Marine Auxiliary Machinery Course

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Abstract: *Project-based teaching mode is an important teaching method in the current college teaching process. It has obvious effect on the cultivation of creative quality of talents. Project-based teaching emphasizes taking students as the main body and learning as the center. Based on a course in marine auxiliary machinery, centrifugal pump cavitation was selected to explore and practice project-based teaching. The application results show that the project-based teaching method can improve the classroom teaching effect to a certain extent.*

Keywords: *Project-based teaching; creative quality of talents; pump cavitation*

1. Introduction

In order to deal with a new round of technological and industrial reform, "New Engineering" has been issued, which puts forward higher requirements for higher education in colleges and universities, requiring to cultivate a group of innovative outstanding engineers with solid theoretical knowledge, comprehensive professional ability and high quality[1]. "New Engineering" emphasizes that universities with engineering superiority should play a main role in engineering science and technology innovation and industrial innovation. Undergraduate course teaching is the foundation of our country's higher education, aiming at some problems existing in key fields such as professional structure setting, construction and training of teachers, practical ability and innovation and entrepreneurship ability of college students, General Office of the State Council issued “Opinions on Deepening the Reform of Innovation and Entrepreneurship Education in Institutions of higher Learning”[2]. At present, most of undergraduate colleges and universities respond to the call of the state actively, with the goal of cultivating high-quality talents with comprehensive and coordinated development of the trinity of "knowledge-ability-accomplishment", optimize the talent training mechanism, update the teaching concept and reform the teaching mode. Project-based Learning (PBL) attaches great importance to the selection and implementation of the project, the display of the results, and the evaluation and summary of teachers. In various ways of teaching reform methods, project-based Learning has become one of the important means.

2. Theory and development of project-based Learning

Project Based Learning (PBL) was first proposed by Kapoor, American progressive educationalist, in the early 20th century. He believes that the biggest advantage of project-based learning is that students can acquire substantial knowledge and skills through actions based on actual life[3]. Later, this teaching model gained attention in European educational circles and became one of the effective ways to cultivate students' comprehensive ability.

For the definition of project-based learning, experts and scholars in different fields at home and abroad have different interpretations. Zhang Xiaosu believes that "project-based learning refers to the teaching method centering on a preset situation in the teaching process[4]. In this process, students acquire knowledge and skills through activities, cooperate with each other to complete works, solve problems with the help of teachers and make independent evaluation and summary.

In my opinion, project-based learning is a classic teaching method that is very popular among teachers and students. Unlike traditional teaching, project-based learning requires students to complete concrete projects to learn knowledge, master methods, and develop abilities. Project-based learning is a

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new teaching model that pays more attention to meaningful knowledge construction. It can also cultivate students' thinking ability and exploring spirit.

The theoretical foundations of project-based teaching mainly include constructivism, the theory of pragmatism education (Dewey), and Bruner's scenario cognition discovery learning theory. In the view of constructivism, the learning of basic items is essentially an inquiry learning mode based on the basic constructivism learning theory. In the process of project-based teaching, students are the main body, so that students can explore the connotation of knowledge by themselves in the project, instead of teachers' direct explanation. Constructivism emphasizes the "situational" nature of learning, and groups complete projects through "cooperation" and "communication".

Therefore, project-based learning emphasizes group cooperative learning in real situations. In the process of completing a complete project, we can directly participate in the whole process of teaching through self-directed learning to achieve the ultimate goal of meaning construction.

3. The general process of project-based teaching

Project-based learning emphasizes students' independent inquiry, cooperative learning, and requires students to explore real problems based on real life situations. The usual implementation steps include project topic selection, project planning, project implementation, achievement presentation and project evaluation, as shown in Figure 1:

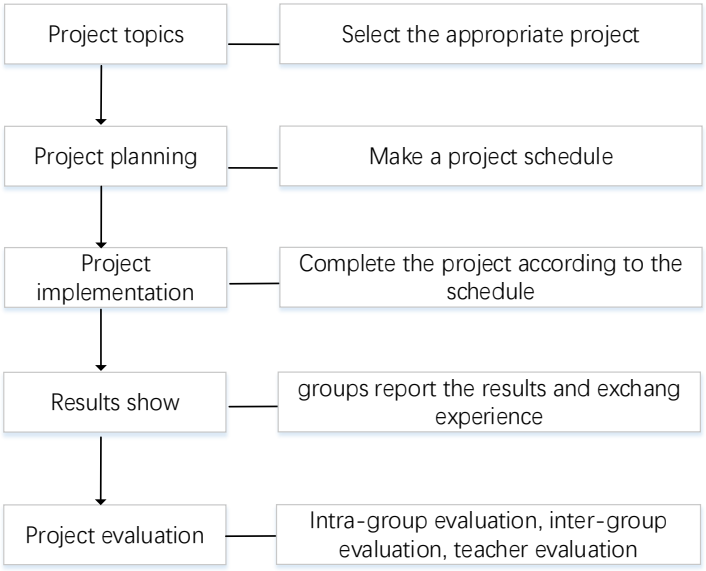

Figure 1: The general process of project-based teaching

The selection of the project is the key to the whole learning, the project is designed according to the basic conditions, cognitive level and ability of students.

The development of project-based learning mostly needs group cooperation, many people work together to complete the project, we must have a clear and detailed activity arrangement and plan. For example, breaking down the project, each person responsible for one part of it, how long it will take to complete. The plan should be as detailed as possible. And it can be adjusted at any time if there is any change in the implementation process. Teachers can help students list the main content of the plan, the division of roles, equipment and tools needed, the main steps, and the schedule.

The implementation of project learning is an important feature that distinguishes project-based learning from other teaching modes. Team members shall carry out the project in an orderly manner according to the established project schedule. Students will deepen their understanding and application of knowledge and skills. It can cultivate students' autonomous learning ability, hands-on ability, teamwork ability, problem-solving ability, information collection ability and so on.

After the completion of the project, each group will show the work in class, communicate with each other, and share their feelings about the work production. The exchange of results can be various forms, such as lectures, debates and so on. The exhibition is not simply to show the works. Team members should explain the idea, process, improvement plan, production principle, innovation, deficiency,

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harvest and reflection of the project. The presentation provides students with an opportunity to communicate and retell the production of the whole work in their own words. It can exercise students' ability of expression and logical thinking.

After each group's project work has been presented, the other groups will evaluate the work. The evaluation is more than just evaluating results, but also includes quantitative evaluation and qualitative evaluation, formative evaluation and terminal evaluation. It may also include evaluations of individuals and of groups, self-evaluations and evaluations by others. The teacher makes the project evaluation form. Each group completed the scoring and summarized the results. This formation of competitive mechanism is conducive to stimulate students' learning motivation.

4. Application and effect analysis of project-based teaching

4.1 Project topics

The selection of the project is the key to the whole learning process. The project is designed based on students' basic conditions, cognitive level and ability. On the basis of soliciting students' opinions, analyzing the feasibility of the project and fully considering the theme and research value, we select the first article of marine auxiliary machinery– pump to carry on project - based teaching exploration practice.

4.1.1 Project content analysis

This part is an important knowledge module in marine auxiliary machinery. Centrifugal pump is the essential mechanical and electrical equipment on the ship. It determines the operation of many important equipment and even the vitality of the ship. Therefore, the centrifugal pump is the key content of the course. Through the study of this part, students can master the professional knowledge of Marine pump function, composition, principle, performance, use, maintenance and management.

4.1.2 The project objects

The program is aimed at seventh semester undergraduate students majoring in energy and power engineering.

4.1.3 Project analysis and design

The project learning content is cavitation and prevention measures of centrifugal pump. The reasons, mechanisms and preventive measures of cavitation are discussed through examples. Through theoretical analysis, the methods of preventing and eliminating cavitation under different operating conditions are studied. And through the actual troubleshooting process learning, it can guide students to deepen the understanding of cavitation, finally learn to analyze and deal with the typical fault method of centrifugal pump.(see Fig. 2).

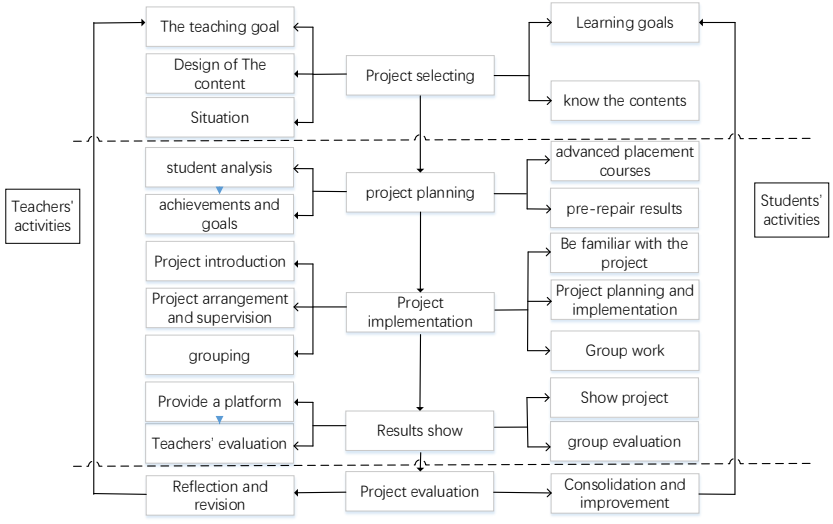

Figure 2: Project implementation process details

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4.2 Project planning

4.2.1 Learning analysis

Have completed the leading courses: Engineering Thermodynamics and Heat Transfer, Mechanical Fundamentals I, Engineering Drawing I, Engineering Mechanics, Fluid Mechanics, etc.

4.2.2 Achievement objectives

The learning objectives are shown in Table 1：

(1) Understand the functions and classification of Marine pumps;

(2) Be familiar with flow rate, head, power, efficiency, suction vacuum, installation height and cavitation allowance;

(3) Master the working principle of centrifugal pump, characteristic curve of centrifugal pump and piping device characteristic curve;

(4)Be familiar with the centrifugal pump flow rate and flow control method; Grasp the reason of cavitation and anti-cavitation performance of centrifugal pump.

Table 1: Teaching goals

number	level	content
1	know	function, classify
2	acquainted	Parameters: flow rate, head, power, efficiency, suction vacuumand cavitation margin
3	master	the principle, characteristic curve, flow regulation method, cavitation
4	analysis	cavitation and its causes
5	discriminate	methods of management, methods of fault judgment

4.3 Project Implementation

Project-based teaching is introduced by two pump cases.

Case 1. After the pump was used for a period of time, the drainage temperature become higher, and the outlet pressure fluctuated, vibration and displacement reduced. Later it was found that the pump impeller had been damaged by cavitation.

Case 2: The pump for fire fighting produced noise after using for a period of time, and the outlet pressure is unstable, and the flow rate decreases seriously. After disassembly and inspection, it is found that the pump impeller is seriously eroded.

4.3.1 Project arrangement and supervision

Teachers defined project tasks and activities in project-based teaching activities， shown in Table 2 .Each group organized, digested and implemented the projects. The degree of implementation affected the quality of the final output. It was often the case that the higher the degree of implementation, the higher the quality of outputs.

Table 2: Practice schedule

schedule	the project name	planning
days 1-2	component 1	the role and function of centrifugal pump
	component 2	main performance parameters of Centrifugal pump
days 3-4	component 1	how it works
	component 2	characteristic curves、method of flow regulation
days 5-6	component 1	hazards caused by cavitation/mechanism of cavitation
	component 2	measures to prevent cavitation
days 7-10	component 1	management of centrifugal pump
	component 2	analysis and judgment of common faults

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4.3.2 Groups in project-based teaching

Group learning or cooperative learning is a very important part of the project-based teaching process. The project is designed to be attractive and moderately challenging for students. At the beginning of the project, teachers stipulate that the form of group cooperation should be adopted. The teachers ask the group to make a work plan, determine the division of labor, and organize some group activities, such as brainstorming, hands-on collaboration and so on. Early cooperative task is relatively simple and straightforward, and every group member can participate. This helps the group develop a collaborative atmosphere. Members can achieve unexpected results through cooperation, so that the subsequent cooperation is very smooth.

4.3.3 Project explanation and guidance

Explanation refers to the process of incorporating new knowledge into the project at the beginning of the project design. In some tasks of the project, teachers provide targeted explanation and learning materials to help students complete the task smoothly.

4.4 Achievement display and project evaluation

After the project is completed, each group presents the work in class. Students communicate with each other and share their feelings about the production of works. In the form of reports and debates, team members explain the ideas, process, improvement plan, production principle, innovation, deficiency, harvest and reflection of the project.

After each group's project report is completed, the other group's project will be evaluated. The teacher made the project evaluation form, scored the project according to the items of each group's self-evaluation, mutual evaluation and teacher evaluation, and summarized the results.

5. Summary

Project-based teaching method is a new teaching mode which is task-driven and project-oriented. It has become an effective means to cultivate students' comprehensive practical ability. The implementation of project-based teaching requires the effective integration of the resources of universities and local governments. At the same time, actively guide students to participate in the project implementation.

Improve teachers' comprehensive ability

Project-based teaching poses new challenges to teachers' teaching ability. On the one hand, teachers must have strong scientific research ability, and have a clear understanding of the theoretical frontier and policy orientation of the subject. On the other hand, must accumulate certain industry practical experience, and have strong practical ability.

To promote the improvement of students' autonomous learning ability

Project-based teaching is characterized by the combination of theoretical learning and project practice to improve students' theoretical level and practical ability. This requires students to have strong autonomous learning ability. The traditional way of students' academic assessment is generally carried out by examination. Therefore, the process assessment of students in the implementation of the project cannot be effectively carried out. It cann't reflect students' ability to use knowledge in an all-round way. Therefore, the process assessment is mainly carried out in the form of daily work, node assessment, project practice, project presentation and so on. In this way, we can not only pay attention to the students' ability in course learning, but also pay attention to the students' autonomous and cooperative learning ability reflected in the process of project implementation. The exploration of project-based teaching is not only to cultivate students' knowledge and skills, but also to cultivate students' inquiry-based learning.

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